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**Skenandore, Isaiah D.** ***An analysis of the current ergonomic conditions and practices for office-based administrative employees within Organization XYZ***

## Abstract

The lack of ergonomic design and injury prevention based activities for Organization XYZ are likely to be resulting in the occurrence of musculoskeletal disorders among its office employees. A literature review covered four main concepts including the history of ergonomics, losses in an office environment, analysis and assessment tools, and office-based ergonomic controls. An ergonomic analysis was performed on several employees of Organization XYZ along with a questionnaire, loss run analysis, and evaluation of the current ergonomic program activities. The research results indicated that Organization XYZ does not have a formal ergonomic program while various other workstation design deficiencies were found in the office-based work environment. Furthermore, the loss run data did not exhibit any musculoskeletal disorders present in Organization XYZ's administrative staff although the analyses and questionnaires identified numerous ergonomic related losses. The recommendations based on this research indicate the implementation of an ergonomic policy that includes commitment from top management, a written program, employee involvement, routine employee training, workstation analyses, and follow-up of employees' reported symptoms coupled with other discussed engineering and administrative controls may minimize the organization's potential for loss.

## Acknowledgments

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I would also like to convey my appreciation to Dr. Finder on being the guiding light for this research paper. Dr. Finder required a meticulous attention to detail throughout this process that has truly made me a better writer. I also express my thanks to Dr. Finder for convincing me I had the wherewithal to complete a Graduate Degree while I was an undergraduate at the University of Wisconsin Stout. Dr. Finder along with Dr. Michael Galloy have been the foundation of my academic success for the past eight years.

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## Chapter I: Introduction

In today's world of economic struggles, it appears as though organizations are continuously searching for ways to improve their overall profitability. Ergonomics is a way to not only increase organizational profitability, but increase workers morale, and longevity (Peate & Lunda, 2002). In simple terms, ergonomics is the interaction of humans in relation to the workplace, and this concept has likely been around since humans created and interacted with their first tools (The Human Factors Section Health, Safety and Human Factors Laboratory Eastman Kodak Company, 1983). What has probably become more accepted knowledge today is the need to consider this human to work relationship even more importantly due to vast differences in the size and shape of the current world's population (The Eastman Kodak Company, 2004).

By the very nature of the work, office-based administrative employees are subjected to several ergonomic risks which consist of unnatural positions, highly repetitive tasks, and psychological stresses (Grandjean, 1987), and these individuals may be required to perform tasks that the human anatomy was not designed for (Chetty, 2010). These risk factors, when combined with an aging workforce, heighten the potential for substantial losses that can be mitigated if proactive workstation design concepts are applied (Peate & Lunda, 2002). These losses not only affect an organization's bottom line, but employees, their families, and the overall community (Chasen, 2009). In 2008, office and administrative support workers in the United States suffered 80,410 musculoskeletal disorders (Bureau of Labor Statistics, 2009). Although workers can recover from musculoskeletal disorders in weeks or months following the diagnosis and treatment of such ailments, others who are affected may deal with debilitating symptoms for the remainder of their lives (Peate & Lunda, 2002).

Organization XYZ maintains and operates various functions/activities within one and a half million square feet of facilities that are located in the upper mid-west part of the United States. These facilities include schools, office space, casinos, gas stations, convenience stores, recreation buildings, health service facilities, a museum, an automotive repair facility and other business-oriented entities. Organization XYZ is also responsible for maintaining roads, a fleet of light and heavy vehicles, parking lots, burial grounds, and other assets as such are acquired. Approximately 185 individuals are employed to maintain various facilities as well as provide the above-mentioned services through functional areas which are segregated into departments such as administration, facilities management, automotive, grounds keeping, custodial, electrical, and plumbing.

The office-based administrative employees within Organization XYZ provide various forms of support in the areas of secretarial, management, accounting, continuous improvement, and operations analysis. Several employees who work within this administrative group have experienced a type of musculoskeletal disorder due to the likely presence of one or more ergonomic risks. Ergonomic injuries reported from employees within Organization XYZ have primarily consisted of wrist orientated carpal tunnel syndrome and lower back issues, although these ailments cannot be used solely to judge the current conditions within the workplace, as many musculoskeletal disorders take years to develop. Therefore, a lack of ergonomic design and injury prevention based activities for Organization XYZ are likely to be resulting in the occurrence of musculoskeletal disorders among its office employees.

**Purpose of the Study**

The purpose of this study will be to analyze the current workplace conditions and ergonomic practices that are being performed by office-based administrative employees within Organization XYZ.

**Goals of the Study**

The goals of this study are as follows.

- Analyze various office related workstations to identify if significant ergonomic-based risk factors are present
- Survey employees regarding the occurrence of musculoskeletal disorders
- Analyze loss related data of administrative employees for the past three years
- Analyze ergonomic program activities that are currently being performed by Organization XYZ

**Background and Significance**

Organization XYZ is confronted with a process deficiency which likely involves the design of the workplace and the resulting ergonomic losses will probably continue to affect employees unless management-supported controls are made available to help mitigate the uncontrolled risk factors which are contributing to the losses. Ergonomic-based losses not only elicit a substantial monetary effect on an organization, but such events also possess the ability to lower an injured employee's standard of living. The data gathered in this study may demonstrate the need for the development of an ergonomic policy within Organization XYZ which may ultimately improve worker morale, decrease the potential for musculoskeletal injury, increase production and efficiency, increase customer service, and increase organizational profitability.

The benefits which gained from this study will likely create a positive effect on Organization XYZ's employees, the workers' families, various internal and external customers, and the overall community. Unless workplace-oriented changes are instituted with regard to the area of ergonomics, the previously mentioned forms of loss will likely continue within Organization XYZ as its workforce ages and becomes more vulnerable to recognized stressors. Employees that have already experienced a certain amount of physical loss can only regain what their musculoskeletal system and modern medicine will allow. However, employees who have yet to experience a specific musculoskeletal injury can retain the mobility, dexterity and quality of life that they currently possess if identified ergonomic stresses can be corrected (Peate & Lunda, 2002).

**Assumptions of the Study**

There are several assumptions to this study. They are listed as follows.

- It is assumed that employees are will provide honest answers during the survey/questionnaire portion of the data collection process.

**Limitations of the Study**

There are several limitations to this study that are listed below.

- **Availability of the participants.** Day to day operations limit the availability of participants as the study will not impede Organization XYZ's ability to provide administrative duties to its customers. Participation will be granted by management's approval of availability.
- **Sample size.** The sample size will include Organization XYZ's office-based administrative employees.

- **Top Management Support.** Achieving top management support will be significantly important to this study, allowing access to employees to collect data.
- **Time.** The time frame for this study will be from October 4, 2012 until December 7, 2012.

**Definition of Terms**

**Ergonomics.** "Ergonomics is a multidisciplinary activity striving to assemble information on people's capacities and capabilities for use in designing jobs, products, workplaces, and equipment." (The Human Factors Section Health, Safety and Human Factors Laboratory Eastman Kodak Company, 1983, p. 3) Ergonomics is also referred to as human factors, human factors engineering, and human engineering. Although some feel there are differences in the terminologies, for the purpose of this study they will all be referred to as ergonomics.

**Work related musculoskeletal disorders.** Work related musculoskeletal disorders (WMSD's) are musculoskeletal disorders such as chronic muscle, tendon, and nerve disorders. These disorders are caused from repetitive tasks, force, unnatural postures, work duration, and psychosocial issues (ACGIH, 2012). Cumulative trauma disorders (CTD's), repetitive motion illnesses (RMI's), and repetitive strain injuries (RSI's) are other terms utilized in the profession.

**Anthropometrics.** Anthropometrics is defined as the measurement of human beings including their size and shape (The Measure of Man & Woman). This data proves useful when designing a workplace for employees to accommodate their variations.

## Chapter II: Literature Review

The purpose of this study was to analyze the current workplace activities and ergonomic design approaches that are utilized by office-based administrative employees within Organization XYZ. This literature review will demonstrate the importance of ergonomic based practices in the workplace as well as the means to effectively identify and correct related stressors which may contribute to illness/injury along with other asset downgrading situations. To accomplish this, the literature review will be divided into four main sections which address ergonomic history, related losses, analysis and assessment tools, and controls.

### History of Ergonomics

The term ergonomics originates from two words in the Greek lexicon. Ergon is the Greek word for work while nomos translates to law (Bridger, 2009). Therefore, this term is traditionally interpreted as the means of analyzing how work activities affect individuals (The Eastman Kodak Company, 2004). By analyzing how specific tasks affect workers, ergonomics allows employers to design a workplace to significantly benefit the employee. These benefits will be discussed in further detail later in this chapter. Ergonomics is a continuing profession because as time progresses, more is learned about the biomechanics, engineering, anthropometry, physiology, and human factors between people and their workplaces (Chasen, 2009).

When the history of this concept is reflected upon, it can be reasonably argued that ergonomics is as old as mankind (Peate & Lunda, 2002). Evidence of ergonomic practices can be traced back to the first tools that were carved out of wood or stone to fit human hands, thus allowing the tools to be utilized in an effective and efficient manner. A study of ancient history demonstrates humans' ability to understand the importance of ergonomics. A classic example of this realization is demonstrated by the Song Dynasty of China, which utilized such concepts in

their military. This dynasty was successful, in part, due to the fact that it considered the size and weight of its soldiers while developing standards for armor and weapons (Karwowski, 2006). Simple human variation is important to consider when evaluating a workplace, especially when considering many readily available technologies and concepts utilized in the past may not be presently implemented.

Prior to ergonomic-based advances, innumerous losses have been recognized throughout history. In the 1800s, many telegraph workers complained of telegraphists' cramp (Peate & Lunda, 2002). When Henry Ford introduced the assembly line in 1905, ergonomic-based losses were observed by employees performing limited job responsibilities which focused stress on muscles and tendons. Later, in the 1900s, English cotton workers in the textile industry reporting cramping and weakness in the hand. Both telegraphists' cramp and cotton twister's wrist are forms of upper limb disorders. These specific disorders are a type of tenosynovitis which affects the synovial sheath surrounding tendons by causing a buildup of fluid under the sheath, leading to swelling and pain (The Eastman Kodak Company, 2004). As a result of ergonomic-based losses, advances in ergonomics became a priority in workplaces (Main, 2007).

The industrial revolution created machinery which humans interacted with on a regular basis. As a result of technical advances placing much greater interaction between the human and the machine, ergonomics became a necessity in the 20th century (Bridger, 2009). However, work-related musculoskeletal disorders (WMSDs) were still common afflictions among workers. It wasn't until World War II that ergonomics and human factors took two different approaches in analyzing how people interact with their workplace. Ergonomics analyzed how work affects people, while human factors focused more on how humans interact with the machines. The goal during the war years was to create weapons that provided the highest efficiency and effectiveness

for soldiers to use. Thus, it was during these times that modern ergonomics was born (The Human Factors Section Health, Safety and Human Factors Laboratory Eastman Kodak Company, 1983).

Post World War II, the knowledge of ergonomic lessons which were learned was applied throughout modern industry. Several individuals may trace roots of modern ergonomics to the aerospace industry, as a place where the interaction between man and machine came to the forefront (MacLeod, 1995). The future of ergonomics is a developing field, and it is likely that ergonomists will be analyzing technology that cannot yet be fathomed. However, there is still room for improvement in the interaction between today's worker and their workplace.

**Office Workplaces**

In 1706, Bernardo Ramazzini already identified problems related to office work. He reported that musculoskeletal based diseases arise from three causes which include constant sitting, the perpetual motion of the hand in the same manner, and the attention and application of the mind. Constant writing considerably fatigues the hand and the whole arm on account of the continual tension of the muscles and tendons (Violante, Armstrong, & Kilbom, 2001). Ramazzini described the negative effects of office work when such workplaces were still fairly primitive. Little could Ramazzini have known how accurately he predicted the adverse effects that office work would currently have on employees.

It appears that the size as well as the sophistication of office workplaces has grown vastly over the past 60 years. One of the first computers used for commercial administration was the Lyons Electronic Office, located in England (Grandjean, 1987). Data was entered into the computer by way of punch cards, in a slow procedure by today’s standards. This slow procedure is ergonomically friendly, avoiding the fast repetitive motions of modern workers. Office

technology has progressed a long way since then. Computerization has been to the office what the assembly line work was to the automotive industry. Early typists had the small luxury of regular breaks through the tasks of adding paper, and hitting the return stroke. Today's computers offer automated return strokes, no paper to load, and a high level of typing speed and skill that most typists in years past would dream of. Modern administrative workers may sit at a computer for hours at a time, compiling over 10,000 keystrokes an hour (Peate & Lunda, 2002). It would appear likely that these highly repetitive jobs place employees in unnatural postures for long periods of time and lead directly to the ergonomic related losses that office workers are currently experiencing.

**Ergonomic Related Losses in Office Environments**

To understand the importance of ergonomic studies, the losses associated with ineffective practices must be explained. Ergonomic-related losses typically stem from WMSDs. Five factors that contribute to WMSDs include force, posture, repetition, duration, and stress/anxiety (Bridger, 2009, p. 170). The presence of one or more of these five ergonomic hazards leads to the WMSDs that cause employees to seek medical attention. It is estimated that 85% of all musculoskeletal disorders are work-related (Chetty, 2010). Another hazard to be considered is poor work organization which may cause worker stress and anxiety. This can be identified as jobs that disengage the employee, promote boredom, or are just otherwise uninteresting. Work organization can define and influence many of the recognized ergonomic risk factors mentioned above (Moon & Sauter, 1996). Victims of poor work organization may become frustrated and lose focus of their work, often times creating a psychosocial environment that contributes to the development of WMSDs (Chetty, 2010).

It may be argued that all WMSDs could be caused by non-work related activities such as sports, medical background, genetics, and various other non-work related issues (Goetsch, 2008). According to the American Conference of Industrial Hygienists' Threshold Limit Values and Biological exposure Indices for 2012, there are numerous non-occupational factors which could cause musculoskeletal disorders. These conditions may include rheumatoid arthritis, endocrinological disorders, acute trauma, obesity, pregnancy, age, gender, level of physical condition, previous injuries, diabetes, and recreational/leisure activities (p. 172-173). The conflict between pre-existing worker conditions and the presence of workplace stresses may fuel the debate over who will pay for the treatment of employees who develop WMSDs, although employers should still prioritize lowering the ergonomic risk factors to improve the overall financial stability of the organization.

**Upper extremity disorders common to office work**

There are numerous WMSD's that affect employees, but this study will focus on the upper limb and back disorders that typically inconvenience office based administrative employees (Bureau of Labor Statistics, 2009). Upper extremity disorders are common in office-based work settings (Chasen, 2009). WMSDs occur in the upper body at a higher frequency than in the lower body and typically target the shoulders, elbows, wrists, forearms, lower back, upper back, neck, and eyes. Although there are a variety of WMSDs, the ones that primarily affect office-based employees include Carpal Tunnel Syndrome and lower back disorders (Chasen, 2009).

Carpal Tunnel Syndrome (CTS) is a disorder which results from the median nerve being compressed in the wrist (Butler, 1995; Goetsch, 2008; Falkiner, Myers, 2002). This disorder is the result of awkward motions and postures that lead to the tendons in the wrist becoming

inflamed. These motions and postures consist of the wrist flexion and extension along with sustained wrist deviation (Karwowski & Marras, The Occupational Ergonomics Handbook, 1999). In the hand, nine tendons run through the carpal tunnel along with the median nerve. A synovial sheath covers each tendon for protection and lubrication. When the wrist routinely deviates from a neutral position, it places strain on the sheath, thus causing it to become inflamed. This inflammation then compresses the median nerve which is located within the carpal tunnel. Once this nerve becomes compressed, a form of paralysis develops in the wrist.

The symptoms of CTS may be derived from three types of motor, sensory, and autonomic nerve impairments (Karwowski & Marras, The Occupational Ergonomics Handbook, 1999). Reduced motor nerve impairment leads to the diminished use of the thumb while sensory nerve impairment is an apparently noticeable symptom which leads to burning, prickling, and tingling sensations in the wrist, thumb, index, and middle fingers. Several sufferers of CTS complain of sensory nerve impairment occurring during the evening as it will awaken them from sleep (Butler, 1995). A symptom of autonomic nerve impairment is the loss of sweat production as the body loses its ability to sense temperature. All of these symptoms are considerably debilitating to employees who make a living with their hands.

CTS is one of the WMSDs commonly to affect office based administrative employees. According to Falkiner and Myers (2002), 99 out of 100,000 Americans will develop CTS, and approximately 450,000 release-based surgeries occur each year which costs over two billion dollars. CTS is a controversial WMSD because several experts consider that its cause is consequent from genetics, rather than work-related (Falkiner, Myers, 2002). If this claim becomes substantiated and accepted, it could have a vast effect on current industry practices of

employers incurring the costs of CTS treatment. Either way it's viewed, employee suffering as a result of this disorder will likely continue to reduce an organization's profitability.

**Lower Back Disorders**

It is reasonably argued that lower back pain is the largest burden in industry, because it affects the most workers (Chasen, 2009). WMSDs that afflict the lower back may be the most debilitating as the nerves affected could cause pain all over the body. It is predicted that at any time, 15%-20% of the population is experiencing symptoms of lower back pain (Violante, Armstrong, & Kilbom, 2001). Static work postures incorporated in long periods of sedentary sitting by office based administrative staff may lead to an increase in lower back pain (Karwowski & Marras, The Occupational Ergonomics Handbook, 1999). This back pain is directly related to the spine which is made up of vertebrae that are separated by pliable disks and allow human motion to be possible (MacLeod, 1995). The vertebrae provide the ability for the torso to bend and twist, which also causes such components to suffer considerable wear and tear if physical actions are performed in a repeated and/or forceful manner.

Non-specific lower back pain is a frequently recurring complaint in the workplace, and is prevalent in office-based employees who tend to be in a seated posture for extended periods of time. One of the reasons that non-specific lower back pain occurs is because the synovial fluid that lubricates joints becomes dislodged, allowing for damaging movement upon standing or shifting as the disks are no longer lubricated. It is believed that the un-lubricated disk movement may cause the sciatica nerve to become disrupted, causing pain in various regions of the body (Violante, Armstrong, & Kilbom, 2001).

Another lower back affliction is the development of a degenerative disc disorder, which occurs when the discs begin to harden, narrow, fissure and crack (MacLeod, 1995). Once this

occurs, the disc may herniate and thus lead to direct pressure on the nerves in the spinal cord that could cause pain throughout the body, but typically in the lower extremities (Karwowski & Marras, The Occupational Ergonomics Handbook, 1999). These injuries are incapacitating to the employee and require surgery to repair the damage. Cervical radiculopathy is an upper spine disorder that occurs from repeated postures, such as holding a phone, resulting in disc degeneration, ruptured discs, and/or arthritis that places pressure on the cervical nerve (Goetsch, 2008). Prolonged exposure to un-natural postures in the upper spine may eventually make it difficult to turn one's neck. Although there are numerous other types of WMSDs which develop in the workplace, the two aforementioned are ailments often prevalent in an office-based setting and therefore will be focused on in this study.

**WMSD-based losses to organizations**

Organizations will suffer from a substantial reduction in organizational profitability when they encounter repeated ergonomic-based losses (Main, 2007). The following data provides an idea of the magnitude of ergonomics losses in the United States of America:

| | |
|---|---|
| Lower Back Disabilities: | $56,000,000,000 a year (Apts, 1992) |
| Carpal Tunnel Syndrome: | $2,000,000,000 a year (Falkiner & Myers, 2002) |
| Estimated Total Losses in 1998: | $1,260,000,000,000 (Peate & Lunda, 2002) |

The numbers above include direct and indirect costs. Direct costs consist primarily of medical expenditures and lost production, while indirect costs include items such as downtime, replacement employee costs, and quality variances (Peate & Lunda, 2002). Of the 1.26 trillion in estimated losses, 418 billion resulted from direct costs while 837 billion are attributed to indirect costs providing for a 2:1 ratio of indirect costs compared to direct costs. Not only will organizations suffer an immediate up-front cost, but indirect costs will continue to hamper the

bottom line. Others break the cost analysis down into short-term, moderate-term, and long-term costs. The following Table 1.1 from Peate and Lunda (2002) conveys the effects of each cost:

Table 1 Cost Analysis

| **Short-term Costs** | Moderate-term Costs | Long-term Costs |
|---|---|---|
| Productivity | **Productivity** | **Decreased customer satisfaction** |
| Absentees | **Workers' compensation premiums** | **Reduced job security** |
| Injury/illness | **Revision of work practices** | **Loss of career advancement** |
| Job turnover | **Decreased quality** | **Loss of recreational activities** |
| Temporary worker cost | **Decreased employee retention** | **Disrupted family and other relationships (divorce)** |
| Pain/suffering | **Loss of self esteem** | **Loss of home, benefits, etc.** |
| Risk management administrative time | **Risk management administrative time** | **Risk management administrative time** |

The costs, whether short-term, moderate-term, or long-term, may quickly accumulate when ergonomic-based losses are allowed to occur repeatedly. Lost time injuries which occur when an employee misses a day of work are a common result of WMSDs (Peate & Lunda, 2002). Since employees and employers are often unaware of ergonomic hazards, an organization's first sign of a problem appears when a loss has already occurred (Chasen, 2009). As is expressed in Table 1.1, the costs to an organization affect components other than their bottom line. These costs may degrade the image of an organization by indicating possible indifference for its employees' health and well-being.

Costs accrued from ergonomic-based losses may considerably affect an organization when such occur in an office-based setting. Compared to occupations with a high rate of work-related injuries, office-based workers are considered to be in a low risk position (Bureau of

Labor Statistics, 2009). This is of high concern for organizations experiencing loss in office-based workers, especially since they are only considered to provide administrative services, and not directly contributing to organizational profitability. Ergonomic-based losses are often considered the cost of doing business. This is a flawed approach in that effective and efficient ergonomic practices may actually save organizations money by lowering insurance costs. It is also arguable that proper ergonomic practices may earn organizations money by increasing employee morale, translating into an increase in production (MacLeod, 1995). One of the primary money-saving areas in ergonomics is that of worker compensation. By law, all organizations must provide worker compensation benefits to their employees. The worker compensation premium that an employer pays is based on the modification factor of their organization, which is a ratio comparing the organizations injury rate to the national average (Peate & Lunda, 2002). When an organization suffers a loss such as a WMSD, its modification factor increases and raises the premium, thus directly affecting profitability. By limiting ergonomic-based losses, the insurance experience modification factor remains low and may potentially provide a competitive edge to an organization.

An organization has the potential to mitigate costs associated with ergonomic-based losses by analyzing certain factors. Determinants that should be examined include accident and incident reports, OSHA 300 logs, insurance company/ third party administrator loss runs, litigation records, and indirect and direct costs (Peate&Lunda, 2002). Peate and Lunda list the types of loss data that should be collected:

- Category of loss: Work injury, property damage, auto accident, etc.
- Date/time of loss: Year, date, day of week, time of day.
- Claimant: Name, date of birth, date of hire.
- Location: Unit, division, plant, department, college, etc.

- Hazard: Force, posture, repetition, duration, and environment (Bridger, 2009)
- Cause: Repetitive motion, overexertion, workplace design, workload, etc.
- Injury: What WMSD's occurred, sprain/strain, disease, swelling, part of body, etc. (p. 290)

While analyzing losses, it is important to identify trends within the data. A focus on frequently occurring and serious losses will identify the opportunities for change, which will markedly impact an organization (Main, 2007).

**Ergonomic analysis and assessment tools**

An ergonomic analysis needs to be performed to provide an organization with the information essential to make effective changes. These analyses should include an objective or purpose, subjective history, observations, recommendations, and expected outcomes (Chasen, 2009). Main (2007) discusses how an ergonomic analysis may be conducted and reported in two steps. The ergonomic risk factors acknowledged by Bridger (2009) including force, posture, repetition, duration, and environment need to be identified first. Those risk factors are then quantified, and a plan is formulated for corrective action or mitigation which is the second step. Once the two steps of the ergonomic assessment are implemented, the risk can be controlled or eliminated.

Of the five risk factors addressed by Bridger, posture, repetition, duration, and environment are those which directly affect modern office workers (Pillastrini, et al., 2007). Office-based work is often light and meticulous and it typically does not utilize enough force to cause an immediate manifestation of WMSDs. However, poor postures may cause strain on various regions of an employee's body, leading directly to the WMSD's affecting today's office workforce (The Eastman Kodak Company, 2004). Repetition is another key ergonomic hazard for office-based workers who are continuously repeating specific motions such as keystroking. Duration is an integral part of the risk factors that office based workers are exposed to since the

majority of office-based employees are sitting for hours at a time (Butler, 1995). Although office environments are controlled, thus alleviating cold and heat stresses, psychosocial aspects such as workload and stress along with lighting concerns play an important part in WMSD's (Grandjean, 1987).

An area of concern while performing ergonomic analyses is the possibility of developing analysis paralysis, which impairs the ergonomist from implementing solutions. Although analysis is important in identifying the hazards, it is imperative to implement solutions as soon as possible (Washington State Department of Labor and Industries, 2010). Accelerated corrective actions satisfy employees and offers expedite solutions for ergonomic related hazards. In order to perform an effective analysis, ergonomic assessment tools must be utilized.

**Ergonomic Assessment Tools**

Ergonomic assessment tools are utilized by analysts to determine the specific actions and conditions which are present in a work setting (Stanton & Young, 1999). Although it is acknowledged that there are numerous tools available, this study will focus on discussing four primary assessment tools which include task observation, the Rapid Upper Limb Assessment (RULA), anthropometrics, and employee surveys/questionnaires. These four assessment tools should provide ample information to allow analysts to adequately mitigate previously discussed ergonomic risk factors.

Task observation is passive in nature as an analyst attempts to identify ergonomic hazards by observing how the employee interacts with the workplace. Common tools needed for observations in office-based settings include a dual function camera and a tape measure. Photos or videos taken with a camera provide the ability to recognize and document angles in an employee's posture, while simple measurements will be further used in an anthropometric

analysis. Ergonomists may also use a goniometer to measure angles. An assessment tool that may be useful during task observation is an assessment checklist (Chasen, 2009). A checklist will provide an analyst with the information that needs to be gathered to make effective changes to ergonomic practices while standardizing the assessment. Chasen, Peate and Lunda, and OSHA all provide respectable checklists which analysts can utilize. It is imperative to ensure the employee is comfortable during the assessment process so the analyst observes routine work posture and basic tasks such as typing, mouse operation, and phone utilization.

Peate and Lunda (2002) discuss the importance of a task observation to assess the work, the worker, and the nonphysical aspects of an organization. Nonphysical aspects may include morale, conflict among coworkers, and overall happiness. Assessing the work that is being performed will enlighten the analyst to the repetition and duration that is required in office-based work. Observing the worker will also reveal the work angle and posture being utilized. If any negative nonphysical aspects describe above are observed, they should be addressed so as to provide the organization an opportunity for improvement.

Task observation should also assess the work environment. Observation of the environment may reveal unfavorable conditions, such as adverse lighting and contrast which may result in undue strain to an employee's eyes (Grandjean, 1987). Direct glare and indirect glare are two concerns affecting the eye strain of an employee. Direct glare is light that shines directly in the worker's eyes while indirect glare is perceived reflecting from a surface. Poor lighting conditions that affect the eye lead to symptoms including fatigue, pain, burning, itching, and blurred or double vision.

An assessment that is useful in an office based setting is the Rapid Upper Limb Assessment, or the RULA. The RULA, located in Appendix A, was developed by Dr. E. Nigel

Corlett and Dr. Lynn McAtamney of the University of Nottingham's Institute for Occupational Ergonomics for the purpose of focusing on upper limb disorders and the risk factors involved with them (Rapid Upper Limb Assessment INSY 3021, 2005). It was also designed to be a quick survey and screening tool. To perform this, the RULA focuses on a specific work task and evaluates how it affects an employee's neck, trunk, and upper limbs. By utilizing the postural angles determined in task observation, the arm, wrist, neck, trunk, and legs are analyzed and given a number based on the severity of the postural angle and other specific items. Fifteen steps are performed to provide a final score of 1-7, with 1 being acceptable and 7 indicating a cause to investigate and immediately change. The RULA is highly effective when used in conjunction with other assessment tools and therefore is not designed to be implemented alone. By actually quantifying the risk of an employee, this assessment will provide the ability to select individuals who will benefit most from a full ergonomic assessment including the four assessment tools mentioned in this study.

Anthropometrics is a Greek word meaning the measurement of man and is a particularly important area in the ergonomic profession (Bridger, 2009). It is the analysis of human measurements to produce equipment that will work for the majority of people (Karwowski, 2006). Utilizing anthropometrics allows product design to meet the ergonomic requirements for roughly 90 percent of the population (Karwowski, 2006). This allows for ergonomically friendly equipment to be accessible to the majority of office employees. Figure 1 depicts the measurements of anthropometric data which is derived from Kodak's Ergonomic Design for People at Work, 2nd Ed. P. 49. It's these measurements that allow analysts to provide employees a specific range they should adjust their office equipment to help mitigate poor postural angles commonly found in office-based settings.

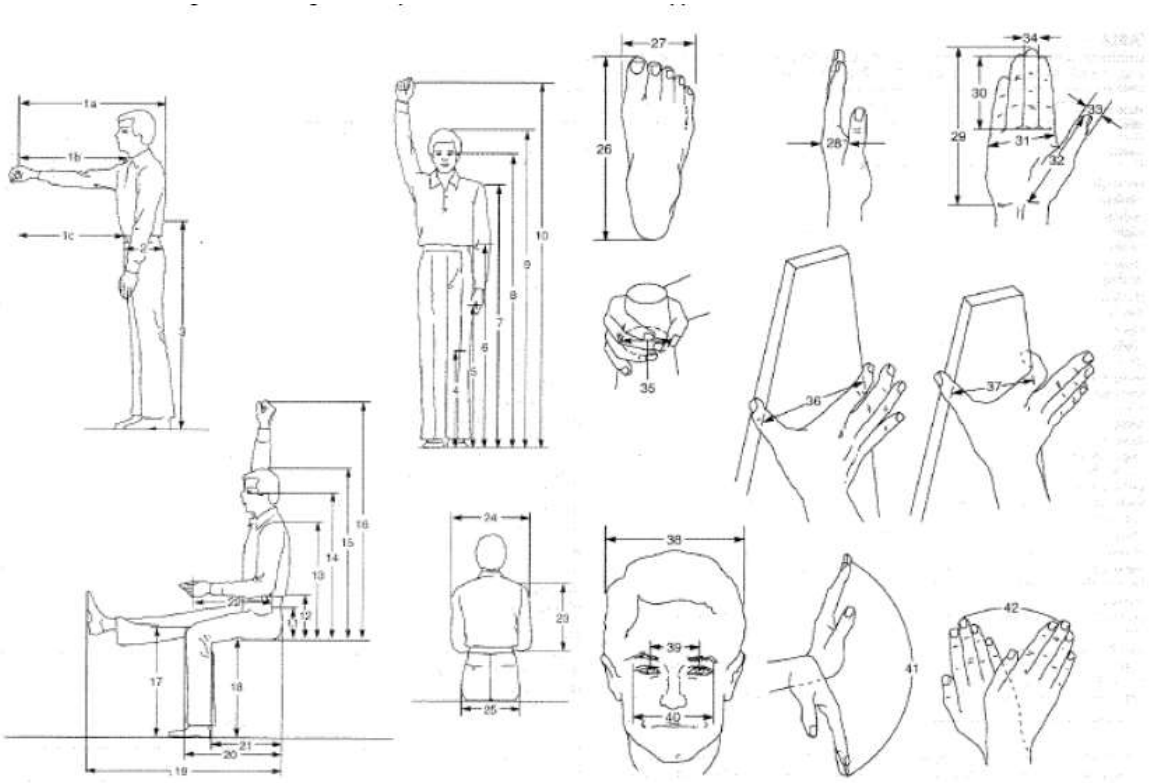


*Figure 1.* Measurements of anthropometric data retrieved from Kodak's Ergonomic Design for People at Work, 2nd Ed. P. 49

Tilley and Associates (2002) discuss specific recommendations to be used in office-based settings to help mitigate ergonomic risk hazards related to unfavorable postural angles to include:

- The seat height should adjust vertically from 14.5 to 19.5 inches to accommodate all workers. Adjust the seat height so that the front edge carries no load.
- If the chair has a backrest, its height should be 25 inches for shoulder support, 36 inches for head support, and 15.7 inches for arm reach-over.
- Up-and-down lumbar support adjustments should be four inches while in and out adjustments of a two inch minimum are needed.
- Upholstery should provide comfort, friction, and ventilation. Avoid coarse fabrics.
- Armrests should be 2-3.5 inches wide and 10 inches forward of the seat reference point and may be padded softly.

- The chair should swivel and have five or six individual feet.
- Table height should be adjustable 23-29 inches for women and 25-31 inches for men with an alternate design is a fixed table height of 28.25 inches for all adult men and women.
- A separate shelf required for the keyboard must travel from 23 to 28.25 inches and be large enough for using a mouse.
- The height of the keyboard should be situated in a manner that the hand and forearm should be in a nearly straight line, deviating less than five degrees, with the operator taking frequent rest periods (p. 59-60).

These specific recommendation items were developed by utilizing anthropometric data gathered from the measurements depicted in Figure 1. These measurements can be used to provide a specific measurement range for employees to utilize based on their height. Simple math may be used to find what specific measurement would provide the most ergonomic comfort, however each employee may enjoy their office-based equipment set up slightly differently.

To improve the workplace for employees, anthropometrics should be used along with task observation so the analyst may provide recommendations for a specific employee based on his/her size and height. (Pheasant, 1986). This worker specific data allows employees to gain knowledge regarding ergonomically friendly positions, thus mitigating ergonomic related hazards. The last of the assessment tools to be discussed in this literature review is the employee survey. Employee surveys are highly effective in finding quantitative and qualitative data on employees in the workforce (Stanton & Young, 1999). Surveys will provide data on how employees perceive a work environment, and if any WMSD symptoms are currently being experienced.

When developing surveys, the questions asked are the key component to gathering valuable information that can be quantified for the recognition of hazards Open-ended questions, which may have lengthy answers, and closed-ended questions with concise answers can both effectively gather valuable information (Cushman & Rosenberg, 1991). Another popular survey technique is the Likert, scale which allows the subject to choose how closely they agree or disagree with a given statement. It is important to mix several types of questions in a survey to gather valuable, pertinent information (Stanton & Young, 1999). The previously discussed assessment tools are a small sampling of the vast amount of tools available to an ergonomic assessor. For the purpose of this study, the four primary assessment tools of task observation, the Rapid Upper Limb Assessment (RULA), anthropometrics, and employee surveys/questionnaires will be utilized to help reduce previously discussed ergonomic risk factors

**Office-Based Ergonomic Controls**

The ergonomic design of office equipment has evolved since the days of the first computer. Today's offices incorporate equipment including flat screen monitors, technologically advanced software, modern office furniture, and input equipment such as keyboards and a mouse (U.S. Department of Labor, 1997). This equipment is utilized by office employees on a daily basis, and ergonomics strives to reduce and eliminate the related injuries associated with this interaction.

To mitigate a hazard in the workplace, it needs to be addressed with an appropriate ergonomic control. Such hazard controls may be either engineering or administrative in nature (The Human Factors Section Health, Safety and Human Factors Laboratory Eastman Kodak Company, 1983). Both controls are utilized to eliminate or reduce the exposure to the hazard.

Engineering controls address the physical aspects of the hazard while administrative controls address the procedural side of the hazard. An example of this could be a fall hazard from an exposed edge of a roof. Installing a guard rail would be an engineering control which eliminates the possibility of an employee falling, while an administrative control would be implemented in the form of a policy requiring the employee to not expose themselves to a fall hazard by remaining six feet away from a roof edge (Peate & Lunda, 2002).

**Engineering Controls**

Engineering controls are frequently found in an office work environment, and they are often preferred as the first method of hazard mitigation (Peate & Lunda, 2002). Considering that all of the items in an office setting are engineered, it is feasible to alter or change them to reduce hazards in the workplace, although it may require a substantial financial investment (Chasen, 2009). Examples of engineering controls in an office-based workplace include ergonomic keyboards, monitors, input devices, and chairs. Environment controls such as lighting, air conditioning, and noise reduction have the capabilities to reduce workplace hazards that may lead to WMSDs.

Keyboards are a vital part of an office-based workplace as employees may type thousands of keystrokes in one hour (Grandjean, 1987). Alternative keyboard designs take into consideration the variation of employee's physical characteristics that were previously discussed in the review of anthropometrics. Following are several common engineering controls that may benefit workers as Peate and Lunda describe (p. 150):

- Tented keyboard-The two keyboard halves are tilted up similar to tent to reduce the rotation of the forearms.
- Built in wrist/palm rests-prevent bending of the hands to support the wrist.

- Key position-alternative key designs curve the keyboard to the natural position of the fingers to reduce finger movement.
- Split keyboard- Move the keys apart to help straighten the wrist. It's used in conjunction with tilting the keys to keep the wrist in its normal posture.
- Key bowl-Two domes are moved laterally on an alphanumeric input device that limits the flexion and extension of the wrist and finger movement.
- Revised layout- The traditional layout is called QWERTY and was actually designed to slow typist down from jamming typewriters with the home row layout of "asdfghjkl". New layouts increase speed and efficiency by placing the most commonly used keys on the home row such as the Dvorak layout of "aoeuidhtns." These revised layouts require a learning curve for those who have previously worked with the original QWERTY keyboard.

These differing types of keyboards all provide the end user a variance to the traditional straight keyboard that has plagued innumerous workers by forcing them to pronate their palms down and constantly deviate the wrist in order to complete the typing task (The Eastman Kodak Company, 2004). The unnatural typing position traditional keyboards require creates an opportunity for WMSDs to develop. A knowledgeable ergonomic analyst should be able to identify an effective keyboard to help mitigate the ergonomic risk factors hampering an employee.

Computer monitors are another component that workers utilize on a regular basis. As previously mentioned by Grandjean (1987), the engineering control of proper lighting is important to relieve the eye strain that plagues many workers, and this is applicable to the brightness and contrast of a computer screen. As the head is naturally angled slightly down in cervical flexion of 10-15 degrees, it is recommended to position the top of the monitor at roughly eye level to alleviate possible neck strain. It is also important to consider monitor position for workers who are wearing bifocals that need to view downward through a specific part of the lens

for close work. The monitor should also be positioned 16-29 inches away from the viewer to allow the eyes to focus properly (Washington State Department of Labor and Industries, 2010). Reversed display screens utilize dark characters on a bright background and have become standard in office workplaces, thus substantially reducing contrast issues. Glare, sharpness, resolution, and size remain important factors to consider when organizations select monitors for employees. Glare, which consists of light that negatively affects the worker's eye directly or indirectly as discussed in task observation techniques, can be controlled with strategic lighting placements and the use of blinds on windows, while sharpness and resolution are determined by the quality of computer monitor purchased. Dull characters and low resolution can cause the eye to strain while focusing, eventually leading to headaches and pain (Grandjean, 1987).

Engineering controls must be applied to input devices that office employees physically work with. A commonly utilized input device which deserves adequate attention is the mouse. The mouse's position should allow the operator's arm to remain close to the body and form a relatively straight line from the hand to forearm with a slight bend, which is considered the most natural (U.S. Department of Labor, 1997). Maintaining the natural position of the arm, as in Figure 2, is directly related to reducing the worker's exposure to hazardous strains by avoiding the postures that typically lead to WMSDs (The Eastman Kodak Company, 2004). There are several mouse designs to allow the hand and wrist to remain in neutral positions including roller, vertical, and trackballs that all attempt to maintain the wrist in the most neutral position possible.

Working in an office-based environment would not be practical without chairs, which are considered the foundation of such workplaces (Department of Consumer and Business Services Oregon OSHA, 2009). Chairs may range from a basic four-legged model with a stiff back to being extensively adjustable. As Peate and Lunda (2002) discuss, ergonomic designs are

*Figure 2.* Two views of natural wrist position
Retrieved from www.risk.unm.edu/health-and-safety/ergonomics/ergonomic-guidelines.php

attainable in either chair type. The priority of an ergonomic analyst is to find a chair that fits the worker, and designs possess the capabilities to change the anthropometric range to meet the requirements of a wider range of people. Key components of an ergonomic chair include a backrest for lower back support in the lumbar area, a cushioned and rounded seat-pan with a front that curves downward to eliminate pinch points to the legs, and vertically/horizontally adjustable armrests which support the forearms without restricting movement (Department of Consumer and Business Services Oregon OSHA, 2009). The design combinations of chair components are extensive and all must be considered with regard to effectively meeting the ergonomic needs of office workers.

Ergonomists will find an abundance of engineering controls available to mitigate hazards found in office-based workplaces (Chasen, 2009). Engineering controls apply to the previously discussed essentials of an office workplace, but they may be extended to other items such as paper holders for data entry, headsets, and ergonomic phones that allow the head and neck to remain in neutral positions. Other areas of concern are the office layout and work environment. Several studies indicate that the psychosocial aspects of office work expose employees to an additional risk of developing WMSDs by increasing blood pressure and reducing overall health and wellbeing (Moon & Sauter, 1996). Although not all of the potential hazards in an office environment may be eliminated with engineering controls, they are a highly effective ergonomic tool to assist in the prevention of WMSDs.

**Administrative Controls**

An administrative control limits an employee's exposure to a hazard without actually eliminating it (Peate & Lunda, 2002). Training and ergonomic policies are two administrative controls that are vitally important. Other controls that may reduce exposure to ergonomic risk hazards include stretching programs, mandatory breaks, and job rotation (The Eastman Kodak Company, 2004). Stretching programs in office settings serve a similar purpose as in athletic programs. Butler (1995) discusses the importance of stretching to maintain the body's resilience against ergonomic risk factors which are related to office-based work. Studies discussed in Pheasant (1987) reveal that postural stress found in sedentary workers relate directly to an increase in WMSDs. Stretching programs and breaks prompt the body to be active and dramatically reduce the development of WMSDs (Butler, 1995). Job rotation also serves to deter employees away from constant sedentary work. All of these tools may be implemented in an organization's ergonomic policy.

An ergonomic policy is a formal proactive administrative control that assists in reducing and eliminating losses. According to Goetsch (2008), there are several keys to a successful ergonomic policy including commitment from of top management, a written program, employee involvement, continuous monitoring of the program, and making necessary adjustments based on the results of the monitoring (p. 266). Chasen (2009) suggests similar program elements including equipment standards, workstation setup, proper tools, training, evaluations, ergonomic recommendations, and exercise and stretching programs. Main (2007) discusses nine steps to success that include identifying the opportunity through loss analysis, forming a cross functional team, defining specific problems, outcomes, root causes and solutions, evaluating solution feasibility, implementing solutions and tracking projects, measuring progress, and providing for

employee rewards and recognition (p. 198). An effective ergonomic policy provides numerous benefits including improved employee health and safety, increased morale, higher work quality and productivity, improved competitiveness, decreased absenteeism and turnover, and fewer injuries (Goetsch, 2008). These benefits are coupled with the financial profits from the reduction in direct and indirect costs. To develop a successful ergonomic policy, all management and hourly employees must be held accountable for adhering to the program. The success factors in management-worker participation are listed by Bridger (2009) and include employee involvement, management commitment, along with a positive work climate (p. 19). An ergonomic policy's effectiveness will ultimately rely on employee participation.

The Eastman Kodak Company, (2004) identified several program and policy traps to avoid including the assumption that training to empower employees will be effective, expecting a limited amount of individuals or single department to address ergonomic issues, being unsupportive, relying on typical ergonomic controls to always be effective, and not adjusting the ergonomics process when an organization reorganizes (p. 16-17). It is important to implement an organizational plan for the responsibility of the program. The responsibility typically falls on safety managers and risk management areas (Chasen, 2009). Although this is how organizations tend to delegate an ergonomic policy, it is essential that this responsibility be appointed to the employees performing the work. Another consideration in developing a policy is to include incentives for compliance and discipline for those found non-compliant to the program's requirements. When employees are reinforced with incentives such as gift cards and extra paid vacation days, they are more apt to become involved and supportive in a task (Bridger, 2009).

Once an ergonomics-based policy has been developed and implemented by an organization, the work is not over. Continuous improvements need to be applied so the policy

remains as effective as possible. These improvements may include job hazard analysis, or JHAs, which break the job into specific tasks which are then analyzed individually (The Eastman Kodak Company, 2004). Tasks that are identified to present a hazard are assigned an abatement method to reduce or eliminate the ergonomic issue. JHAs are an excellent continuous improvement tool as they may be performed annually to identify deficiencies in the work environment over time. They may also be utilized in training new employees along with retraining the more experienced individuals who may have developed poor work-related habits. Another tool is the questionnaire or survey which is completed by the employee. Questionnaires and surveys, as previously discussed, provide valuable quantifiable data if they are constructed with reliability and validity (Bridger, 2009).

**Summary**

In this literature review, four main concepts were discussed in limited detail to include history of ergonomics, losses in an office environment, analysis and assessment tools, and office-based ergonomic controls. Ergonomics, the study of how workers interact with their workplace, is traced back to the beginning of civilization. As the world evolved, employers have been financially burdened by the inability of the human body to work flawlessly without experiencing WMSDs. This is evident by the trillions of dollars expected to be lost every year in worker compensation related expenditures.

In an office-based work environment, WMSDs not only lead to significant financial reduction in organizational profitability, but such ailments also cause pain and suffering to affected employees. The primary upper extremity disorders common to office-based employees consist of carpal tunnel syndrome and lower back disorders, and will be the thrust of what is addressed in this study. These losses, however, can be mitigated in the workplace. Several

authors represented in this review validate the feasibility of reducing or eliminating office-based hazards by implementing effective controls identified through an ergonomic analysis of the workplace. To completely analyze the workplace, an analysis of current loss needs to be performed with a focus on the guidance provided by Peate and Lunda (2002).

After an analysis of current losses is performed, the four primary assessment tools that have been effectively illustrated in this literature review consist of task observation, the RULA, anthropometric analysis, and employee surveys/questionnaires. Task observation should be utilized in tandem with the RULA to identify employees who have the highest potential to benefit from a complete ergonomic analysis. Employee surveys/questionnaires are also useful to provide quantifiable data that may also be used to identify problem areas and provide a baseline to gauge the effectiveness of controls once implemented. These tools can be utilized to help develop engineering and administrative controls that may reduce or eliminate ergonomic risk factors. The ergonomic analysis techniques which were presented in this literature review should serve as the foundation for assisting an organization to instill a workplace that is free from the ergonomic risk factors and losses demonstrated in this review. The following chapter will detail the ergonomic analysis techniques that are to be utilized to collect valuable data in order to accomplish the aforementioned loss prevention and workplace analysis-based goals.

# Chapter III: Methodology

The purpose of this study was to analyze the current workplace conditions and ergonomic practices that are being performed by office-based administrative employees within Organization XYZ. In order to achieve this purpose, the following goals were developed:

1. Analyze various office related workstations to identify if significant ergonomic-based risk factors are present
2. Survey employees regarding the occurrence of musculoskeletal disorders
3. Analyze loss related data of administrative employees for the past three years
4. Analyze ergonomic program activities that are currently being performed by Organization XYZ

To meet these goals, this chapter will describe the research processes which involve subject selection and description, instrumentation utilized, data collection and analysis, and the limitations of the study.

## Subject Selection and Description

The sample population for this study included office-based administrative employees for Organization XYZ, which totaled 16 employees. Of these employees, five were selected for formal ergonomic analysis and a brief walkthrough of each office was performed to quickly access where the activity would provide the most benefit. To meet the aforementioned goals, direct employee interaction was essential to perform an ergonomic analysis, thus requiring the adherence to the Health and Human Services Policy for Protection of Human Research Subjects (Title 45 Code of Federal Regulations part 46 A-D) by the University of Wisconsin-Stout Institutional Review Board (IRB).

The sample for goal three involved gathering loss related data for Organization XYZ. This was provided from the Risk Management department, and was derived from loss runs which were originally received from a third party insurance administrator. The loss information provided included the incident date, type of injury, cause of injury, related hazard, body part affected, lost days, total medical cost, and total incurred cost for the dates of October 2007 to May of 2011. This data had been sanitized from the standpoint that all employee names were removed before it was provided to the researcher.

**Instrumentation**

The first step in accomplishing the goals of this study was to develop an ergonomic questionnaire. The questionnaire, located in Appendix B, seeks information regarding the safety culture of Organization XYZ and was developed with attention to the approaches that Cushman and Rosenberg (1991) and Stanton and Young (1999) utilized. Along with quantifiable data gathered by the ranking portion of the questionnaire, qualitative data was provided by those employees who chose to answer the open-ended questions related to training and general safety concerns. Following the questionnaire on safety culture, the extent of ergonomic pain that employees were suffering was also asked. Questionnaires for male and female employees regarding WMSDs, and the pain associated with them, were utilized from on the Cornell University Ergonomics Webpage and located in Appendixes C and D (Hedge, 1999). Although these questionnaires remained anonymous to encourage participation, they were reintroduced during the ergonomic analysis to better understand what forms of WMSDs were affecting employees.

An ergonomic workstation analysis was developed with guidance from Chasen (2009) and Peate and Lunda (2002) that utilized many topics discussed in the previous literature review.

The ergonomic analysis used in this study can be found in Appendix E. In addition to the ergonomic analysis, an ergonomic checklist (Appendix F) and the RULA (Appendix A) were employed in conjunction with the analysis to help quantify the ergonomic risk levels that employees were exposed to. The ergonomic checklist was actually developed by OSHA and reiterated by Peate and Lunda (2002). Workstation assessment tools utilized during the ergonomic analysis consisted of a dual function camera for video and still photos, a tape measure, manual goniometer and AutoCAD 2010 to identify postures, anthropometric data provided from The Eastman Kodak Company (2004), and an inclinometer to identify the incline of the keyboard, monitor, and various positions of the chair. To ensure employee confidentiality, their faces were not included in the video/pictures taken, and the electronic images were stored in a locked cabinet when the researcher was not viewing them.

**Data Collection Procedures**

Procedures for collecting the data required for this study followed a logical sequence. First, the questionnaires were administered to the office-based employees to provide an understanding for the general safety culture presently in place, to identify any ergonomic design and injury prevention techniques that may be in use, and also identify WMSD symptoms that the workers recently experienced. The questionnaires, both symptom and ergonomic program related, were provided by the researcher with consideration that the employees were office-based and knowledgeable in computer use. Employees were asked to fill the questionnaires out and place them in a locked drop box located in the lunch room by a given date. This process permitted the information to be provided free of name and handwriting recognition, thus allowing the employees to remain anonymous. To meet the IRB requirements, an implied consent form, located in Appendix G, was provided to employees along with the questionnaires.

The next step in data collection involved performing an ergonomic analysis on the office workplace. The researcher was allowed to perform a visual ergonomic analysis of available employees with the utilization of workstation assessment tools previously described. Employees who agreed to have their workstations analyzed were required to sign a consent form, located in Appendix H, before the analysis was initiated. The loss run data was provided from the organizations Risk Management Department upon request.

**Data Analysis**

The data gathered through the questionnaires and loss runs was analyzed with the utilization of descriptive statistics to provide Organization XYZ quantifiable data regarding their current safety culture, ergonomic climate, and WMSDs. A loss analysis on the data was performed utilizing concepts provided from Peate and Lunda (2002) and Main (2007) to focus on the frequently occurring and most serious ergonomic-related losses Organization XYZ was experiencing. The analyses provided the ability to trend data and provide baselines to monitor the occurrence and severity of the losses. Trend lines and the aforementioned descriptive statistics were created with tools available in Microsoft Excel 2010.

The data gathered in the ergonomic analysis was compared to available ergonomic controls that would help reduce or mitigate the identified hazards. Any trends identified from the analysis were documented. Anthropometric data was also used during the ergonomic analysis and helped to provide the employee with an acceptable range their office-based equipment should be positioned in.

**Limitations of the Study**

1. The time frame of this study will be from January 7, 2012 until January 31, 2013
2. The sample size of employees whose workstations were analyzed is approximately 31 percent of the population and may not completely depict the current ergonomic situation
3. Employees were not always available or at work as planned and therefore may not be available for the on-site analysis process

# Chapter IV: Results

The purpose of this study was to analyze the current workplace activities and ergonomic design approaches that are utilized by office-based administrative employees within Organization XYZ. In order to meet the requirements of the aforementioned purpose, the following goals were developed:

1. Analyze various office related workstations to identify if significant ergonomic-based risk factors are present
2. Survey employees regarding the occurrence of musculoskeletal disorders
3. Analyze loss related data of administrative employees for the past three years
4. Analyze ergonomic program activities that are currently being performed by Organization XYZ

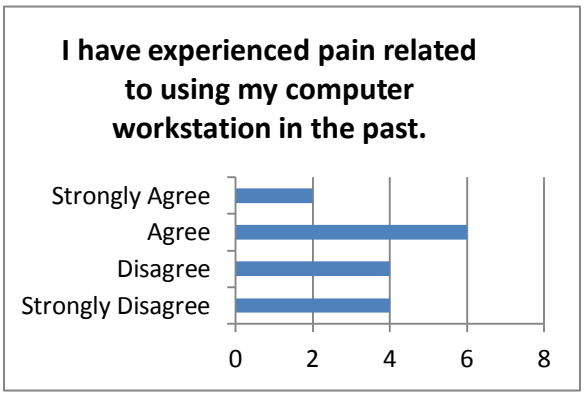
The methodology used to meet the previously stated goals consisted of developing, and distributing an ergonomic questionnaire. Following the questionnaire, an ergonomic analysis was performed to identify potential risk factors causing loss. After the ergonomic analyses were performed, an analysis of loss run data provided from Organization XYZ was completed along with an analysis of the current ergonomic program activities that was accomplished by utilizing the previous data gathered.

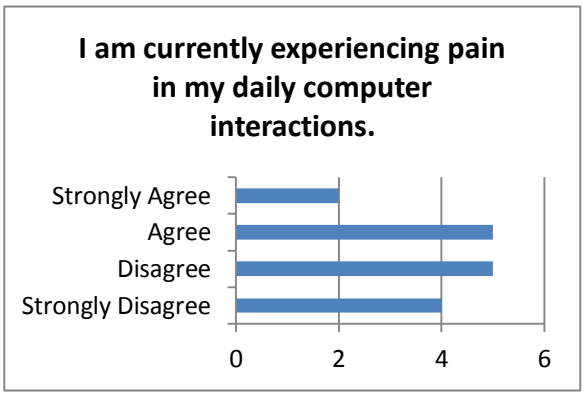
## Presentation of Collected Data

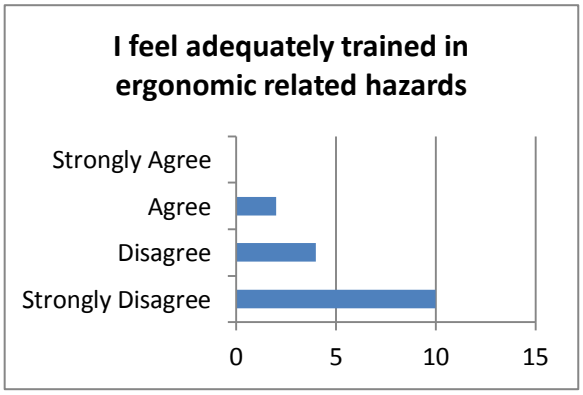
Data in this section is presented in order of the methodology previously described and broken out into four sub-sections which consists of the ergonomic questionnaire, workstation analyses, loss run analysis, and analysis of the current ergonomic program activities. The distribution and collection of the ergonomic questionnaire was initially performed to provide data to accomplish goals numbered two and four. Following the questionnaire, an ergonomic

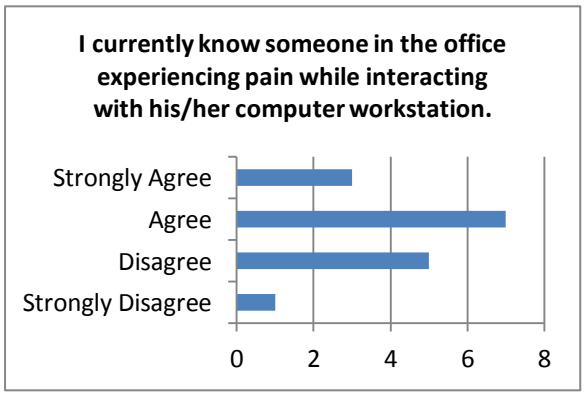
analysis was performed on identified subjects as described in Chapter III. This data directly achieved goal number one and will include an overview of the analyses performed along with the ergonomic-based risk factors identified. The recommendations developed from the analyses will be further described in Chapter V. An analysis of the loss run data gathered from Organization XYZ is depicted in the final sub-section, fulfilling goal number three.

**Ergonomic questionnaire.** The ergonomic questionnaire developed for this study consisted of eight statements that participants either strongly disagreed, disagreed, agreed, or strongly agreed with. Following the eight questions that provide quantifiable data, qualitative data was gathered in two essay format questions. Figure 3, located below, provides a visual description of how the 16 participants responded to the eight questions.



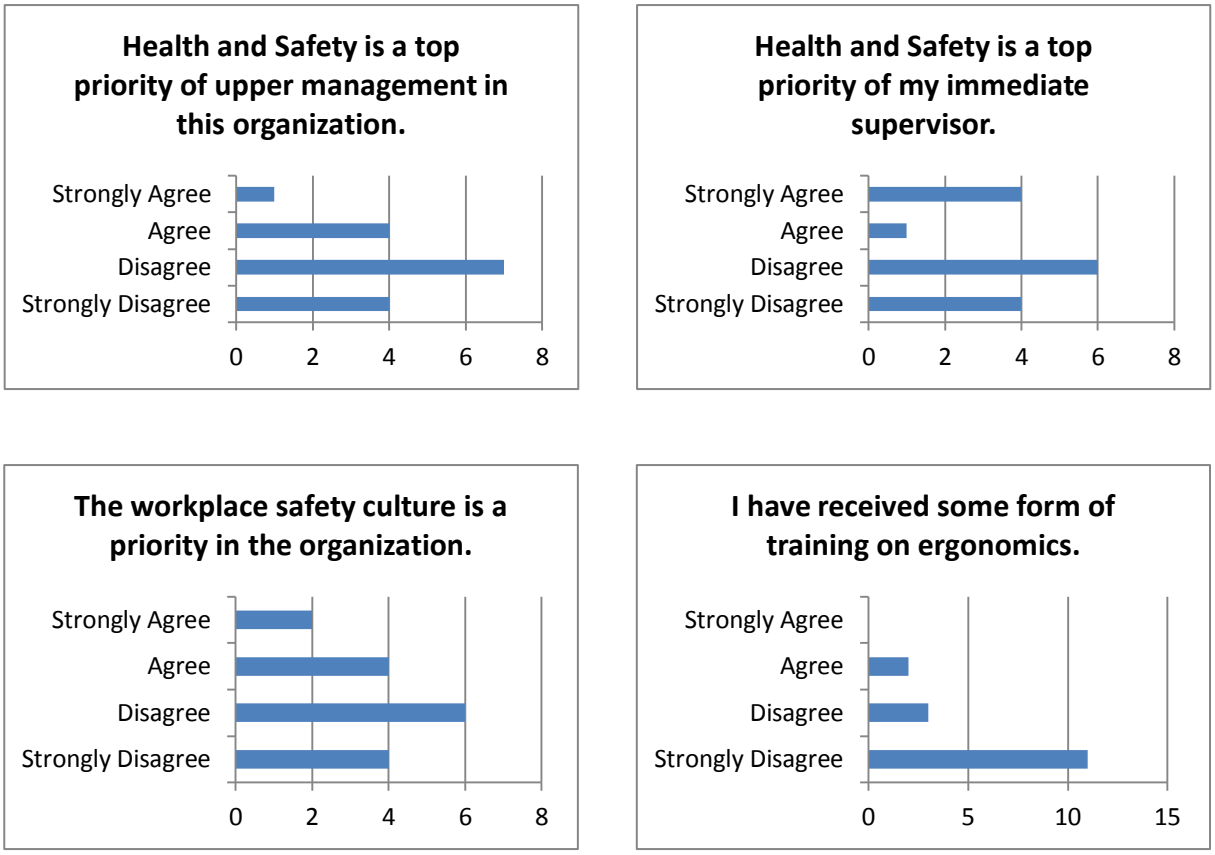



*Figure 3.* Ergonomic Questionnaire results

Of significance among the above questionnaire results is that 87.5% of respondents stated they had not received any form of training on ergonomics. Also of concern is the 43.75% of respondents who stated they are currently experiencing pain in their computer interactions while 62.5% believe that a safety is not a priority. The second part of the questionnaire asked two essay questions. The first question on the questionnaire which was stated as, "Please describe any safety and health training that you have received along with specific training related to ergonomics", gathered the following responses:

- CPR/First-Aid/Forklift
- No ergonomic training CPR/First-aid

- OSHA training at school

The second question which was phrased, "Please list any concerns that you might have regarding the safety culture in the organization", retrieved more responses as follows:

- Need more safety training
- Not enough emphasis on safety
- No rewards for safe behavior
- No procedures available to employees to know what to do when safety issues arise
- No follow-up to safety issues brought up
- More training needed in the organization

**Ergonomic analyses.** Ergonomic analyses were performed on five of the sixteen office-based workers within Organization XYZ. The analysis template utilized in the study can be found in Appendix E. An ergonomic checklist found in Appendix F was not directly filled out for each analysis, but was utilized as an assessment tool to complete the analyses. The RULA form (see Appendix A) was completed for all five analyses to provide quantitative data to go along with the qualitative data gathered. The five participants in the ergonomic analyses all scored a 3 or 4, which indicates that the work task needs further investigation and that change may be needed. This further investigation was completed with an ergonomic analysis.

The ergonomic analysis was comprised of gathering background information, performing a task observation, identifying chair adjustability, collecting inclinometer readings of the keyboard, assessing anthropometric data on the workstation, and researching recommendations. Each analysis began with an overview of the employees' history and any symptoms/injuries experienced related to the office-based work. Four of the employees selected had experienced symptoms related to WMSD's. The employee not currently experiencing symptoms related to

WMSD's is also the youngest of the five selected. Of the four employees who are experiencing pain, three had received medical care including two surgeries related to carpal tunnel syndrome and one medical intervention to alleviate pain in the lower back.

The employees analyzed had several different job duties and titles, however, they all worked in an office-based work environment. Four of the employees selected worked full time (40 hours per week), while one of the employees worked part time (20 hours per week). The work performed at the workstation consisted of primarily computer-based interactions. One position, the receptionist, primarily answered phones and performed various computer interactions.

After discussing employee history, the researcher observed each employee's tasks and performed a visual ergonomic analysis of the employees selected. This resulted in the documentation of several trends depicted below:

- Employees often had their feet unsupported as the chair utilized was raised to allow access to the keyboard and mouse which were located on the desk platform
- Employees often did not have elbow support as the rests were located low and spread out in relation to the employee's elbow's, thus forcing employees to rest their hands on the desktop
- All the chairs being utilized in the analysis only allowed for up and down adjustment
- The lumbar support of the chair was not adjustable. Only one of the employees analyzed was properly utilizing the support with their buttocks tight against the backrest which provided support to the lumbar lordosis of the spine
- Only one employee utilized a keyboard tray, while the others placed the keyboard and mouse on the desktop

- All employees, except the receptionist, had the phone placed a large distance away from their neutral posture which caused forward flexion of the spine coupled with the extension of the arm to answer the phone
- Employees all utilized a straight traditional keyboard that forces them to assume ulnar deviation postures in order to type.


*Figure 4.* Wrist angle and pinch point

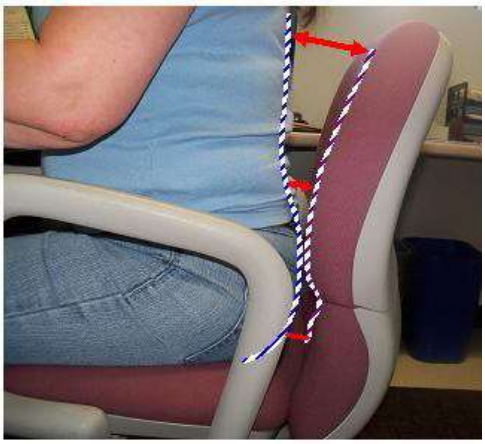


*Figure 5.* Lack of Lumbar support

Figure 4 depicts the 30 degree angle of wrist extension that an employee experiences while interfacing with the keyboard. The area circled depicts the pressure point which is created on the employee's forearm caused by the lack of elbow support and the sheer height of the table/keyboard. This employee suffers from left hand pain that radiates to the lateral epicondyle of the elbow while experiencing a burning sensation along their forearm. The employee is also suffering from low back stiffness and pain. The employee pictured above in Figure 4 has received medical treatment consisting of a wrist support, but has not received surgery for the fore-mentioned conditions.

Chair adjustability was limited to up and down adjustments. The elbow rests were fixed along with the lumbar support as demonstrated in Figure 5 above. The chair could also recline or

be locked in a vertical position. All of the employees analyzed had the chair locked in the vertical position. As exhibited in Figure 5, the employee would have to lean back to utilize the backrest of the chair. This is either caused from the chair back tension not being set tight enough, the monitor set too far away causing the employee to lean forward, or the employee not practicing the "butt-in" approach to utilize the lumbar support and backrest. The seat pan had an adjustment on the bottom to tighten the ability to lean back, although none of the employees were familiar with its operation. An inclinometer was used to measure the incline of the keyboard which varied between 9.5 and 11.5 degrees among the employees who were evaluated.

Anthropometric data was gathered on all of the employees who were analyzed, and the collected information consisted of the workstation seat height, elbow rest height above the seat, seat depth, table height, and keyboard height. The researcher generated a recommended measurement based on cross-multiplying specific workplace measurements of known heights with the employee's height. This data reinforced the trends found during the task observation that appeared to be related to employees utilizing the desktop as the workplace for their keyboard and mouse, thus forcing the workers to raise their chairs and leave the feet unsupported. Another trend reinforced with anthropometric data was the measurements taken related to the employee's chair and the disparity between the actual and recommended measurements. All of the employees analyzed had one or more measurements significantly different than the recommended measurements which were generated by the researcher. Each ergonomic analysis provided recommended controls that will be discussed in Chapter V.

**Loss run analysis.** Organization XYZ provided loss run data on the entire organization for the years of 2009, 2010, and 2011. After a careful review of the data, it was discovered that WMSD's related to office-based work did not exist in the loss runs provided. There were several

muscular strains related to over-lifting, however they were not a result of computer interaction. Through discussions with employees, it became apparent that there were numerous medical treatments related to WMSD's with two surgeries related to carpal tunnel syndrome in 2009, one surgery related to lower back disorders in 2010, and several employees received medical treatment for musculoskeletal disorders. When considering the loss runs did not indicate the aforementioned musculoskeletal issues, it is apparent there is a problem with under-reporting of accidents/injuries. This disconnect appears to be with the medical provider and Organization XYZ's worker compensation insurance company.

**Analysis of the current ergonomic program activities.** It is evident in the information gathered with the questionnaire that Organization XYZ currently does not have an ergonomic program. This was verified with the ergonomic analysis, as employees have not received any training in the identification of ergonomic risk factors. The majority of employees disagreed with the statement, "I feel adequately trained in ergonomic related hazards," as well as, "I have received some form of training on ergonomics," that was provided on the questionnaire. Organization XYZ has an employee health nursing department, however they also serve 1600 employees outside of Organization XYZ. Their primary function is drug screening, tuberculosis testing, follow-up case management, and providing health services such as blood pressure readings and blood diagnostics. This nursing department performed an ergonomic analysis for an Organization XYZ employee in 2008, although the nurse that performed it has since left and there are no other individuals in the department with similar training/background.

**Discussion**

The data collected through the questionnaire and ergonomic analysis reasonably compare with the information and concepts presented in the Chapter II literature review. The upper

extremity disorders and lower back disorders common to office work depicted in the literature review by Chasen (2009) have proven to be the most prevalent WMSD's in the office-based work environment of Organization XYZ, although they are being underreported in the loss runs provided by the organizations' workers compensation third party administrator. This may be an issue with the insurance program and medical providers to the employees of Organization XYY, although the providers should be prompting employees to determine if the injury/illness may be work-related.

Through the ergonomic analysis and questionnaire administered to employees, it is evident there is a lack of safety culture and training when discussing ergonomics. Few employees, 12.5% precisely, felt they received training related to ergonomics. Organization XYZ does not have a formalized ergonomic program. There are numerous administrative and engineering controls that should be applied to Organization XYZ's current ergonomic situation, and those will be discussed in Chapter V.

It may be argued that some of the WMSD's occurring in Organization XYZ could be potentially caused by non-work related activities. As discussed in the literature review, activities such as sports, medical background, genetics, and various other non-work related issues may lead to the occurrence of musculoskeletal disorders which are currently observed. During the ergonomic analyses, several hobbies of the employees were discussed. Three of the four who were experiencing pain related to the upper extremities practiced intricate beadwork. This hobby involves the ergonomic risk factors of repetition, duration, and posture, which may lead to the occurrence of musculoskeletal disorders and may require further analysis.

## Chapter V: Conclusions and Recommendations

A deficiency of ergonomic design and injury prevention based activities for Organization XYZ were likely to be resulting in the occurrence of musculoskeletal disorders found among its office employees. Therefore, the purpose of this study was to analyze the current workplace conditions and ergonomic practices that are being performed by office-based administrative employees within Organization XYZ. The following goals were created at the origin of the study in order to achieve the requirements of the previously described purpose:

1. Analyze various office related workstations to identify if significant ergonomic-based risk factors are present
2. Survey employees regarding the occurrence of musculoskeletal disorders
3. Analyze loss related data of administrative employees for the past three years
4. Analyze ergonomic program activities that are currently being performed by Organization XYZ

The methodology utilized to accomplish the aforementioned goals consisted of developing and distributing an ergonomic questionnaire to satisfy goal number two. Ergonomic analyses on office-based workers were then performed to identify potential risk factors which may be causing loss and thus complete goal number one. Following the analyses, an examination of the loss run data provided from Organization XYZ was completed along with a study of the current ergonomic program activities to meet goals three and four. A literature review prior to the described methodology provided valuable information on ergonomics history, related losses, analysis and assessment tools, and controls. This final chapter is separated into three sections which consist of conclusions, recommendations, and areas identified for further research.

**Conclusions**

This section is organized according to the research goals previously stated. Major findings and conclusions are listed in bullet form.

**Goal number one: Analyze various office related workstations to identify if significant ergonomic-based risk factors are present.**

- A workstation ergonomic analysis was performed for five of Organization XYZ's employees
- The RULA form (see Appendix A) was completed for all participants with final scores between 3 and 4 with a primary deficiency found in the wrist position, specifically the angle of wrist extension and flexion coupled with the ulnar deviation required to utilize the traditional keyboards. A score of 3 to 4 indicates that the work task needs further investigation and that change may be needed.
- All the chairs being utilized in the analysis only allowed for up and down adjustment of the seat. This exposes employees to the undo risk of unnatural postures by not allowing the chair to fit the worker, as describe by The Eastman Kodak Company (2004). Furthermore, the chairs provided were equipped with arm rests which were not height adjustable, thus requiring the employees to rest their forearms on the table for support.
- Only one of the five employees utilized a keyboard tray while the others placed their keyboard and mouse on the desktop which was located approximately 30 inches above the floor. The surface of this desktop is significantly greater than the recommended height of 23-29 inches for women and 25-31 inches for men.
- Employees all utilized a straight traditional keyboard which places their wrists in unnatural ulnar deviation-based postures as described by Peate and Lunda (2002).

**Goal number two: Survey employees regarding the occurrence of musculoskeletal disorders.**

- Eighty-seven and a half percent of questionnaire respondents stated they had not received any form of training on ergonomics. This is contrary to the recommended administrative controls described in the literature review which specify the importance of ergonomic related training as delineated by Chasen (2009) and Main (2007).
- Forty-three point seventy five percent of questionnaire respondents stated they are currently experiencing pain during computer interactions. Of these individuals, two surgeries related to carpal tunnel syndrome occurred in 2009 and one surgery related to lower back disorders were performed in 2010. These are the types of WMSD losses which are expected to occur in office-based work if proper ergonomic design-based considerations are not made during workstation design activities (Chasen, 2009).

**Goal number three: Analyze loss related data of administrative employees for the past three years.**

- Organization XYZ's loss runs for years 2009, 2010, and 2011 did not depict the presence of WMSD's that had occurred, specifically two carpal tunnel syndrome surgeries in 2009 and one lower back disorder surgery in 2010. Furthermore, there were several employees who received medical treatment for musculoskeletal disorders over the three years. This is evidence of under-reporting of accidents/injuries. The literature review in this study did not discuss these issues, as it is normally assumed the medical provider and worker compensation insurance companies ensure proper recording and eventual communication of losses.

**Goal number four: Analyze ergonomic program activities that are currently being performed by Organization XYZ.**

- Organization XYZ does not have a formally recognized ergonomic program and employees stated that they had not received any form of ergonomic related training. Although Organization XYZ has an employee health nursing department, they have not performed an ergonomic analysis of an office-based work environment since 2008. According to Peate and Lunda (2002), a lack of an ergonomic program can directly correlate to the occurrence of WMSD's.
- Only 12.5% of questionnaire respondents stated that training had been performed with regard to the topic of ergonomics. Although this small percentage of individuals responded that training had been performed related to ergonomics, it was unclear whether or not the training was actually performed by Organization XYZ.

**Recommendations**

It is believed that various engineering and administrative process changes may minimize the organization's potential for future ergonomic-based loss and therefore should be implemented as soon as feasible. The first recommendations are related to the ergonomic analyses which were performed on the employees' workstations while the remainder are generated from the other information which was gathered throughout this study.

- Supply ergonomically adjustable chairs. A Steelcase Criterion model is an available option through Organization XYZ's current office furniture provider. These chairs incorporate the key components described by the Department of Consumer and Business Services Oregon OSHA (2009) which consist of backrest with adjustable lumbar support, vertically and horizontally adjustable armrests, and a horizontally adjustable seat pan.

- Provide adjustable keyboard/mouse platforms that are large enough to ensure the mouse and keyboard are located on the same level. The platform should be adjustable in height from 23-31 inches and be capable of tilting forward and backward in order to accommodate the employees' postural preferences.
- Offer an articulating support arm for the computer monitor to adjust the screen beyond the current up and down motion to include adjustability toward and away from the user.
- Equip each employee with ergonomic keyboards which incorporate a tented and/or split keyboard to reduce the extent of forearm pronation and wrist ulnar deviation.
- Provide headsets for employees who primarily engage phone use throughout the workday.
- Incorporate an ergonomic policy according to Goetsch (2008) to include commitment from top management, a written program, employee involvement, routine employee training, routine workstation analyses, and follow-up of employees' reported symptoms. Ensure an organizational plan which identifies the specific points of personnel responsibility to ensure that the policy is generated and adhered to.
- Implement a stretching program and mandatory breaks, when possible, to help employees avoid the postural stress which may occur in sedentary workers.

**Areas of Further Research**

This study was primarily focused on four goals which were established to analyze the current workplace conditions and ergonomic practices that are being performed by office-based administrative employees within Organization XYZ. Although the goals of the study were accomplished, the following were identified as areas requiring further research.

- Conduct additional research on effective ergonomic programs and policies to develop and implement within Organization XYZ.

- Study the effect that employees' hobbies may have on the occurrence and symptoms of WMSD's.
- Perform ergonomic assessments beyond the office-based staff of Organization XYZ as other workplace design and activity deficiencies may exist.
- Examine the cause of under-reporting of loss runs which are provided by Organization XYZ's worker compensation insurance company.

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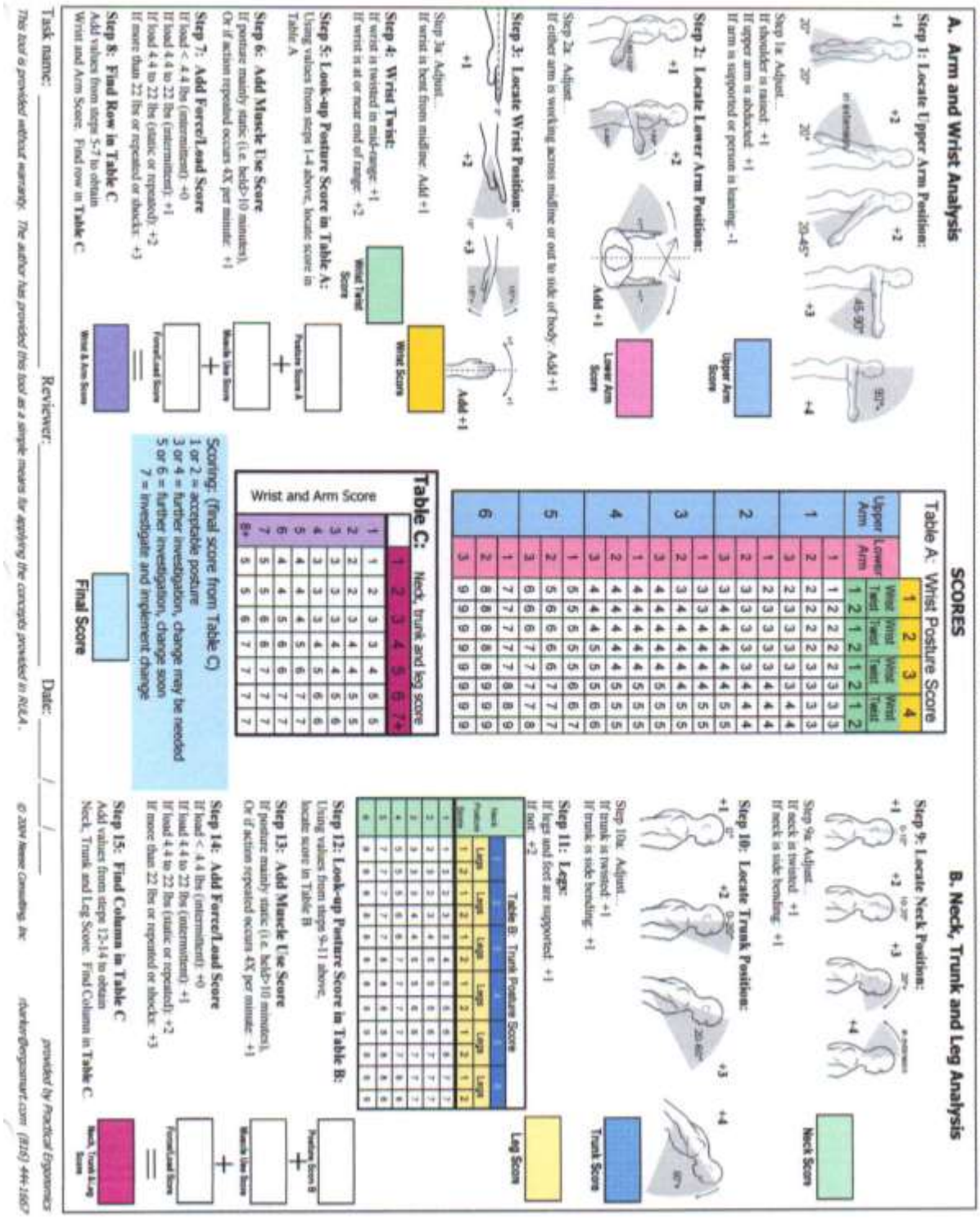
## Appendix A: *RULA Employee Assessment Worksheet*



**RULA Employee Assessment Worksheet**

*Based on: RULA: a survey method for the investigation of work-related upper limb disorders, McAtamney & Corlett, Applied Ergonomics 1993, 24(2), 91-99*

**A. Arm and Wrist Analysis**

**Step 1: Locate Upper Arm Position:** +1, +2, +2, +3, +4; 20°, 20°, 20°-45°, 45-90°, 90°+; is extending

**Step 1a: Adjust...**
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

**Step 2: Locate Lower Arm Position:** +1, +2; 60-100°; Add +1

**Step 2a: Adjust...**
If either arm is working across midline or out to side of body: Add +1

**Step 3: Locate Wrist Position:** +1, +2, +3; 15°, 15°, 15°; Add +1

**Step 3a: Adjust...**
If wrist is bent from midline: Add +1

**Step 4: Wrist Twist:**
If wrist is twisted in mid-range: +1
If wrist is at or near end of range: +2

**Step 5: Look-up Posture Score in Table A:**
Using values from steps 1-4 above, locate score in Table A

**Step 6: Add Muscle Use Score**
If posture mainly static (i.e. held>10 minutes),
Or if action repeated occurs 4X per minute: +1

**Step 7: Add Force/Load Score**
If load < 4.4 lbs (intermittent): +0
If load 4.4 to 22 lbs (intermittent): +1
If load 4.4 to 22 lbs (static or repeated): +2
If load 4.4 to 22 lbs (static or repeated) or shocks: +3
If more than 22 lbs or repeated or shocks: +3

**Step 8: Find Row in Table C**
Add values from steps 5-7 to obtain
Wrist and Arm Score. Find row in **Table C**

**SCORES**

Table A: Wrist Posture Score

| Upper Arm | Lower Arm | 1 Wrist Twist 1 | 1 Wrist Twist 2 | 2 Wrist Twist 1 | 2 Wrist Twist 2 | 3 Wrist Twist 1 | 3 Wrist Twist 2 | 4 Wrist Twist 1 | 4 Wrist Twist 2 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| | 3 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 |
| 2 | 1 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 |
| | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 |
| | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 5 |
| 3 | 1 | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 5 |
| | 2 | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 5 |
| | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 6 |
| 4 | 1 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 |
| | 2 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 |
| | 3 | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 6 |
| 5 | 1 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 7 |
| | 2 | 5 | 6 | 6 | 6 | 6 | 7 | 7 | 7 |
| | 3 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 8 |
| 6 | 1 | 7 | 7 | 7 | 7 | 7 | 8 | 8 | 9 |
| | 2 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 9 |
| | 3 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |

Table C: Neck, trunk and leg score

| Wrist and Arm Score | 1 | 2 | 3 | 4 | 5 | 6 | 7+ |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 |
| 2 | 2 | 2 | 3 | 4 | 4 | 5 | 5 |
| 3 | 3 | 3 | 3 | 4 | 4 | 5 | 6 |
| 4 | 3 | 3 | 3 | 4 | 5 | 6 | 6 |
| 5 | 4 | 4 | 4 | 5 | 6 | 7 | 7 |
| 6 | 4 | 4 | 5 | 6 | 6 | 7 | 7 |
| 7 | 5 | 5 | 6 | 6 | 7 | 7 | 7 |
| 8+ | 5 | 5 | 6 | 7 | 7 | 7 | 7 |

Scoring: (final score from Table C)
1 or 2 = acceptable posture
3 or 4 = further investigation, change may be needed
5 or 6 = further investigation, change soon
7 = investigate and implement change

Final Score

**B. Neck, Trunk and Leg Analysis**

**Step 9: Locate Neck Position:** +1, +2, +3, +4; 0-10°, 10-20°, 20°+

**Step 9a: Adjust...**
If neck is twisted: +1
If neck is side bending: +1

**Step 10: Locate Trunk Position:** +1, +2, +3, +4; 0°, 0-20°, 20-60°, 60°+

**Step 10a: Adjust...**
If trunk is twisted: +1
If trunk is side bending: +1

**Step 11: Legs:**
If legs and feet are supported: +1
If not: +2

Table B: Trunk Posture Score

| Neck Position | Neck Score | 1 Legs | 1 Legs | 2 Legs | 2 Legs | 3 Legs | 3 Legs | 4 Legs | 4 Legs | 5 Legs | 5 Legs | 6 Legs | 6 Legs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| | 2 | 2 | 3 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 7 |
| | 3 | 3 | 5 | 3 | 5 | 4 | 6 | 5 | 6 | 6 | 7 | 7 | 7 |
| 2 | 1 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | 7 |
| | 2 | 3 | 5 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | 7 | 7 | 8 |
| | 3 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 7 | 7 | 8 | 8 | 8 |
| 3 | 1 | 5 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 8 | 8 | 8 |
| | 2 | 7 | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| | 3 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

**Step 12: Look-up Posture Score in Table B:**
Using values from steps 9-11 above,
locate score in Table B

**Step 13: Add Muscle Use Score**
If posture mainly static (i.e. held>10 minutes),
Or if action repeated occurs 4X per minute: +1

**Step 14: Add Force/Load Score**
If load < 4.4 lbs (intermittent): +0
If load 4.4 to 22 lbs (intermittent): +1
If load 4.4 to 22 lbs (static or repeated): +2
If load 4.4 to 22 lbs (static or repeated) or shocks: +3
If more than 22 lbs or repeated or shocks: +3

**Step 15: Find Column in Table C**
Add values from steps 12-14 to obtain
Neck, Trunk and Leg Score. Find Column in **Table C**

Task name: _____ Reviewer: _____ Date: ____/____/____

**Appendix B:** ***Ergonomic Questionnaire***

# Ergonomic Questionnaire

**Please select which box you most closely agree with:**

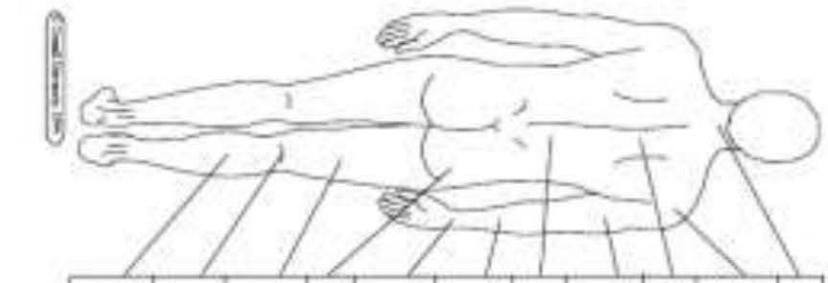
| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| I have experienced pain related to using my computer workstation in the past. | | | | |
| I am currently experiencing pain in my daily computer interactions. | | | | |
| I feel adequately trained in ergonomic related hazards | | | | |
| I currently know someone in the office experiencing pain while interacting with his/her computer workstation. | | | | |
| Health and Safety is a top priority of upper management in this organization. | | | | |
| Health and Safety is a top priority of my immediate supervisor. | | | | |
| The workplace safety culture is a priority in the organization. | | | | |
| I have received some form of training on ergonomics. | | | | |

1. Please describe any safety and health training you have received along with specific training related to ergonomics.

2. Please list any concerns you have for the safety culture in the organization.

Thank you for your time

## Appendix C: *Male WMDS Discomfort Questionnaire*



The diagram below shows the approximate positions of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.

| | During the last week how often did you experience ache, pain, discomfort in: | | | | | If you experienced ache, pain, discomfort, how uncomfortable was this? | | | If you experienced ache, pain, discomfort, did this interfere with your ability to work? | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Never | 1-2 days/week | 3-4 days/week | Once every day | Several times every day | Slightly uncomfortable | Moderately uncomfortable | Very uncomfortable | Not at all | Slightly affected | Substantially affected |
| Neck | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Shoulder (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Shoulder (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Upper Back | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Upper Arm (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Upper Arm (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Lower Back | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Forearm (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Forearm (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Wrist (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Wrist (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Hip/Buttocks | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Thigh (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Thigh (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Knee (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Knee (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Lower Leg (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Lower Leg (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

## Appendix D: *Female WMDS Discomfort Questionnaire*

The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.

| | During the last week much how often did you experience ache, pain, discomfort etc | | | | | If you experienced ache, pain, discomfort, how uncomfortable was this? | | | If you experienced ache, pain, discomfort, did this interfere with your ability to work? | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Never | 1-2 times last week | 3-4 times last week | Once every day | Several times every day | Slightly uncomfortable | Moderately uncomfortable | Very uncomfortable | Not at all | Slightly interfered | Substantially interfered |
| Neck | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Shoulder (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Shoulder (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Upper Back | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Upper Arm (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Upper Arm (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Lower Back | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Forearm (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Forearm (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Wrist (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Wrist (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Hip/Buttocks | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Thigh (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Thigh (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Knee (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Knee (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Lower Leg (Right) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Lower Leg (Left) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Appendix E:** ***Ergonomic Analysis***

| | |
|---|---|
| Evaluator: | |
| Date: | |
| Employee: | |
| Department: | |
| Location: | |
| Position: | |
| Supervisor: | |
| Hours: | |

# Ergonomic Analysis
Office Environment

**Purpose:**

- Addressing Complaints, workplace experiencing loss, etc.

**History:**

- Fill in any symptoms/injuries experienced, employee history

**Job Overview :**

- Day to day activities

**Task Observation:**

- Ergonomic analysis and work activity descriptions with focus on the primary risk factors of posture, repetition, duration, and environment

**Chair Adjustability:**

- Any points of adjustments on chair

**Inclinometer:**

- Results and measurements

| Anthropometric Chair Data<br>Employee Height:___ | | |
|---|---|---|
| **Measurement** | **Actual** | **Recommended Range** |
| Seat Height | | |
| Elbow Rest | | |
| Hand Reach | | |
| Seat Depth | | |
| Table Height | | |
| Keyboard Height | | |
| | | |

**Recommendations:**

- Administrative and Ergonomic Controls

## Appendix F: *Basic Screening Checklist for Office-Based Ergonomic Hazards*

| **Working Conditions**<br>**The workstation is designed or arranged for doing computer tasks so it allows the employee's…** | **Yes** | **No** |
|---|---|---|
| A. **Head** and **neck** to be upright (not bent down/back). | | |
| B. **Head**, **neck** and **trunk** to face forward (not twisted). | | |
| C. **Trunk** to be about perpendicular to floor ( not leaning forward/backward). | | |
| D. **Shoulders** and **upper arms** to be about perpendicular to floor (not stretched forward) and relaxed (not elevated). | | |
| E. **Upper arms** and **elbows** to be close to body (not extended outward). | | |
| F. **Forearms**, **wrists**, and **hands** to be straight and parallel to floor (not pointing up/down). | | |
| G. **Wrists** and **hands** to be straight (not bent up/down or sideways toward little finger. | | |
| H. **Thighs** to be about parallel to floor and lower legs to be about perpendicular to the floor. | | |
| I. **Feet** to rest flat on floor or be supported by a stable footrest. | | |
| J. **Computer tasks** to be organized in a way that allows the employee to vary computer tasks with other work activities, or to take micro-breaks or recovery pauses while working. | | |
| **SEATING**<br>**The chair…** | **Y** | **N** |
| 1. **Backrest** provides support for employee's lower back (lumbar area). | | |
| 2. **Seat width** and **depth** accommodate specific employee (seat pan not to large or small). | | |
| 3. **Seat front** does not press against the back of employee's knees and lower legs (seat pan not too long). | | |
| 4. **Seat** has cushioning and is rounded/ has "waterfall" front (no sharp edge). | | |
| 5. **Armrests** support both forearms while employee performs computer task and do not interfere with movement. | | |
| **KEYBOARD/INPUT DEVICE**<br>**The keyboard/input device is designed or arranged for computer tasks so that…** | **Y** | **N** |
| 6. **Keyboard/input device platform(s)** are stable and large enough to hold keyboard and input device on same level (Keyboard tray). | | |
| 7. **Input device** (mouse or trackball) is located right next to keyboard so it can be operated without reaching. | | |
| 8. **Input device** is easy to activate and shape/size fits hand of the specific employee (not too large or small). | | |
| 9. **Wrists** and **hands** do not rest on sharp or hard edge. | | |

| **MONITOR**<br>**The monitor is designed or arranged for computer tasks so that…** | **Y** | **N** |
|---|---|---|
| 10. **Top line** of screen is at or below eye level so employee is able to read it without flexing head or neck forward or back. | | |
| 11. **Employees with bifocals/trifocals** is able to read screen without flexing their head or neck backward | | |
| 12. **Monitor distance** allows employee to read screen without leaning head, neck or truck forward or backward. | | |
| 13. **Monitor position** is directly in front of employee so employee does not have to twist head or neck. | | |
| 14. **No glare** from windows or light is present on the screen which might cause employee to assume an awkward posture to view the screen comfortably. | | |
| **WORK AREA**<br>**The work area is designed or arranged for doing computer tasks so that…** | **Y** | **N** |
| 15. **Thighs** have clearance space between chair and computer table/keyboard platform. | | |
| 16. **Legs** and **feet** have clearance space under computer table so employee is able to get close enough to the keyboard/input device. | | |
| **ACCESSORIES** | **Y** | **N** |
| 17. **Document holder**, if provided, is stable and large enough to hold documents that are used. | | |
| 18. **Document holder**, if provided, is placed at about the same height and distance as monitor screen so there is little head movement when employee looks from document to screen. | | |
| 19. **Wrist rest**, if provided, is padded and free of sharp and square edges. | | |
| 20. **Wrist rest**, if provided, allows employee to keep forearms, wrists, and hands straight and parallel to ground. | | |
| 21. **Telephone** can be used with head in the upright position and shoulders relaxed if employee does computer tasks at the same time. | | |
| **GENERAL** | **Y** | **N** |
| 22. **Workstation** and **equipment** have sufficient adjustability so that the employee is able to be in a safe working posture and to make occasional changes in posture while performing computer tasks. | | |
| 23. **Computer workstation**, **equipment**, and **accessories** are maintained in serviceable condition and function properly. | | |
| **PASSING SCORE = YES answers on items A-J and no more than two NO answers on checklist 1-23** | | |

Peate and Lunda (2002) p. 324-326

**Appendix G:** ***Implied Consent to Participate In UW-Stout Approved Research***

**Title:**
***An analysis of the current ergonomic conditions and practices for office-based administrative employees within Organization XYZ***

**Research Sponsor:**
*Dr. Brian Finder* *302C*
*Jarvis Hall Science Wing* *Menomonie, WI*
*54751*
*(715)232-1422*

**Investigator:**
*Isaiah Skenandore*
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*Seymour, WI 54165*
*(920)676-2692*
*Skenandorei@my.uwstout.edu*

**Description:**
The purpose of this study will be to analyze the current workplace conditions and ergonomic practices that are being performed by office-based administrative employees within Organization XYZ. In order to meet this purpose, a baseline for the study needs to be established with the administration of an ergonomic and gender specific discomfort questionnaires. The data gathered in the questionnaires will be analyzed and used to identify current ergonomic practices and deficiencies.

**Risks and Benefits:**
There are minimal risks associated with participation in this survey as employees remain anonymous in their answers. Benefits from this portion of the survey will be deduced from an analysis of the results. When incorporated into the whole study, benefits may include an improved ergonomically friendly workplace, reduction of musculoskeletal disorders, and increased employee comfort at the workplace.

**Time Commitment:**
It is estimated that the two questionnaires will take a total of 5-10 minutes to complete depending on the length of the open ended questions.

**Confidentiality:**
To retain confidentiality, all questionnaires filled out will remain anonymous. Employees will fill out the information on their computers, so hand writing recognition is not possible. Employees will not include their name on either of the documents, and once completed, the two documents are to be printed and placed in a locked drop box in the lunch room.

**Right to Withdraw:**
Your participation in this study is entirely voluntary. You may choose not to participate without any adverse consequences to you. You have the right to stop the survey at any time. However, should you choose to participate and later wish to withdraw from the study, there is no way to identify your anonymous documents after they have been turned into the researcher.

## IRB Approval:

This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

**Researcher:**
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**IRB Administrator**
Sue Foxwell, Research Services
152 Vocational Rehabilitation Bldg.
UW-Stout
Menomonie, WI 54751
715.232.2477
foxwells@uwstout.edu

## Statement of Consent:

By completing the following questionnaires, ergonomic and gender specific WMDS discomfort, you agree to participate in the project entitled, ***An analysis of the current ergonomic conditions and practices for office-based administrative employees within Organization XYZ***.

## Appendix H: *Signed Consent to Participate In UW-Stout Approved Research*

**Title:**
***An analysis of the current ergonomic conditions and practices for office-based administrative employees within Organization XYZ***

**Research Sponsor:**
*Dr. Brian Finder* *302C*
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**Investigator:**
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*Seymour, WI 54165*
*(920)676-2692*
*Skenandorei@my.uwstout.edu*

### Description:
The purpose of this study will be to analyze the current workplace conditions and ergonomic practices that are being performed by office-based administrative employees within Organization XYZ. In order to meet this purpose, an ergonomic analysis needs to be performed to gather data on the current ergonomic conditions. The data gathered in the analysis will be used to identify current ergonomic practices and deficiencies to provide recommendations to Organization XYZ.

### Risks and Benefits:
An ergonomic analysis has no inherent risks to the employee. Benefits from an ergonomic analysis may include a more ergonomically correct workplace, reduction of musculoskeletal disorders, and increased employee comfort at the workplace.

### Time Commitment:
It is estimated that the ergonomic analysis will take one to two hours of the employee's time.

### Confidentiality:
To retain confidentiality, all efforts will be made to avoid taking pictures with employee's faces in them. If unavoidable, faces will be blurred out from photos that are utilized in the analysis. Furthermore, names will not be used and all related documents and electronic files will be kept in a locked file when the researcher is not using them. At the conclusion of the study, all documents and photographs will be destroyed.

### Right to Withdraw:
Your participation in this study is entirely voluntary. You may choose not to participate without any adverse consequences to you. Should you choose to participate and later wish to withdraw from the study, you may discontinue your participation at this time without incurring adverse consequences.

## IRB Approval:

This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

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## Statement of Consent:

By signing this consent form you agree to participate in the project entitled, ***An analysis of the current ergonomic conditions and practices for office-based administrative employees within Organization XYZ***.

_____

Signature Date